

WHAT IS CLAIMED IS:

1. A lens for multiple wavelengths condensing plural kinds of monochromatic lights respectively by refraction, the lens comprising:

a lens surface sectioned into plural aspherical zones having different refractive power in a common use area for all the monochromatic lights,

wherein the plural sectioned aspherical zones respectively have one common single focal point corresponding to an inherent wavelength of each of the monochromatic lights,

one focal point corresponding to the inherent wavelength of one of the monochromatic lights is arranged in different position with other focal points corresponding to the inherent wavelengths of other monochromatic lights,

each of the aspherical zones, with regard to each of the monochromatic lights, differs in optical path length from each other by approximately integral multiple of wavelength λ_i (i is an integral number of 1, 2 ... , meaning each of the monochromatic lights) of each of the monochromatic lights, and when a difference between a maximum value and a minimum value of a wavefront aberration of each of the monochromatic lights in each of the aspherical zones is $(\Delta V_d(\lambda_i))$ where d is an integral number of 1, 2 ... , meaning each of the aspherical zones, the difference of a wavefront aberration in each of the aspherical zones is no

more than $0.14 \lambda_i$.

2. A lens according to Claim 1, wherein the wavelength λ_i comprises at least two kinds of wavelength selected from a group of around 790 nm, 655 nm, and 405 nm.

3. A lens for multiple wavelengths condensing two kinds of
5 monochromatic lights respectively by refraction, the lens comprising:

a lens surface sectioned into plural aspherical zones having different refractive power in a common use area for all the monochromatic lights,

wherein the plural sectioned aspherical zones respectively have one common single focal point corresponding to an inherent wavelength of each of the
10 monochromatic lights,

one focal point corresponding to a first inherent wavelength of one of the monochromatic lights is arranged in different position with another focal point corresponding to a second inherent wavelength of another monochromatic light,

each of the aspherical zones, with regard to each of the
15 monochromatic lights, differs in optical path length from each other by approximately integral multiple of wavelength λ_p (p is an integral number of 1 or 2, meaning each of the monochromatic lights) of each of the monochromatic lights, and

when a difference between a maximum value and a minimum value of a wavefront aberration of each of the monochromatic lights in each of the aspherical
20 zones is $(\Delta V_d(\lambda_p))$ where d is an integral number of 1, 2 ... , meaning each of the

aspherical zones, the difference of a wavefront aberration in each of the a spherical zones is no more than $0.14 \lambda_p$.

4. A lens according to Claim 3, wherein the wavelength λ_p comprises two kinds of wavelength selected from a group of around 790 nm, 655 nm, and 405 nm.

5 5. A lens according to Claim 1, wherein the lens condenses each wavelength of light onto an information surface with a Root Mean Square (RMS) wavefront aberration of no more than 0.035λ .

6. A lens according to Claim 3, wherein the lens condenses each wavelengths of light onto an information surface with a Root Mean Square (RMS)
10 wavefront aberration of no more than 0.035λ .

7. An optical head using a lens according to Claim 1.

8. An optical head using a lens according to Claim 3.

9. An optical disc apparatus using a lens according to Claim 1.

10. An optical disc apparatus using a lens according to Claim 3.

15 11. A lens for multiple wavelengths condensing plural kinds of monochromatic lights respectively by refraction, the lens comprising:

a lens surface sectioned into plural aspherical zones having different refractive power in a common use area for all the monochromatic lights,

wherein the plural sectioned aspherical zones respectively have one common single focal point corresponding to an inherent wavelength of each of the monochromatic lights,

one focal point corresponding to the inherent wavelength of one of the monochromatic lights is arranged in different position with other focal points corresponding to the inherent wavelengths of other monochromatic lights,

each of the aspherical zones, with regard to each of the monochromatic lights, differs in optical path length from each other by approximately integral multiple of wavelength λ_i (i is an integral number of 1, 2 ... , meaning each of the monochromatic lights) of each of the monochromatic lights, and

one wavefront aberration for a wavelength with a smaller numerical aperture of the lens is smaller than other wavefront aberration for a wavelength with a larger numerical aperture of the lens in each of the aspherical zones in the common use area.

12. A lens according to Claim 11, wherein the wavelength λ_i comprises at least two kinds of wavelength selected from a group of around 790 nm, 655 nm, and 405 nm.

13. A lens for multiple wavelengths condensing two kinds of monochromatic lights respectively by refraction, the lens comprising:

a lens surface sectioned into plural aspherical zones having different refractive power in a common use area for all the monochromatic lights,

wherein the plural sectioned aspherical zones respectively have one common single focal point corresponding to an inherent wavelength of each of the monochromatic lights,

one focal point corresponding to a first inherent wavelength of one of the monochromatic lights is arranged in different position with another focal point corresponding to a second inherent wavelength of another monochromatic light,

each of the aspherical zones, with regard to each of the monochromatic lights, differs in optical path length from each other by approximately integral multiple of wavelength λ_p (p is an integral number of 1 or 2, meaning each of the monochromatic lights) of each of the monochromatic lights, and

first wavefront aberration for a wavelength with a smaller numerical aperture of the lens is smaller than second wavefront aberration for a wavelength with a larger numerical aperture of the lens in each of the aspherical zones in the common use area.

14. A lens according to Claim 13, wherein the wavelength λ_p comprises two kinds of wavelength selected from a group of around 790 nm, 655 nm, and 405 nm.

15. A design method of a lens for multiple wavelengths condensing plural kinds of monochromatic lights respectively by refraction,

wherein the method designs the lens in such a way that the lens comprises a lens surface sectioned into plural aspherical zones having different refractive power in a common use area for all the monochromatic lights,

the plural sectioned aspherical zones respectively have one common single focal point corresponding to an inherent wavelength of each of the monochromatic lights,

one focal point corresponding to the inherent wavelength of one of the monochromatic lights is arranged in different position with other focal points corresponding to the inherent wavelengths of other monochromatic lights,

each of the aspherical zones, with regard to each of the monochromatic lights, differs in optical path length from each other by approximately integral multiple of wavelength λ_i (i is an integral number of 1, 2 ... , meaning each of the monochromatic lights) of each of the monochromatic lights, and

one wavefront aberration for a wavelength with a smaller numerical aperture of the lens is smaller than other wavefront aberration for a wavelength with a larger numerical aperture of the lens in each of the aspherical zones in the common use area.

16. A design method of a lens for multiple wavelengths condensing two kinds of monochromatic lights respectively by refraction,

wherein the method designs the lens in such a way that the lens comprises a lens surface sectioned into plural aspherical zones having different refractive power in a common use area for all the monochromatic lights,

the plural sectioned aspherical zones respectively have one common single focal point corresponding to an inherent wavelength of each of the monochromatic lights,

one focal point corresponding to a first inherent wavelength of one of the monochromatic lights is arranged in different position with another focal point corresponding to a second inherent wavelength of another monochromatic light,

each of the aspherical zones, with regard to each of the monochromatic lights, differs in optical path length from each other by approximately integral multiple of wavelength λ_p (p is an integral number of 1 or 2, meaning each of the monochromatic lights) of each of the monochromatic lights, and

first wavefront aberration for a wavelength with a smaller numerical aperture of the lens is smaller than second wavefront aberration for a wavelength with a larger numerical aperture of the lens in each of the aspherical zones in the common use area.